

Rec'd PCT/PTC

08 MAR 2005

PATENT COOPERATION TREATY

PCT

REC'D 14 MAR 2005

WIPO

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT



(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PEB371	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP 03/3171	International filing date (day/month/year) 15.10.2003	Priority date (day/month/year) 17.10.2002
International Patent Classification (IPC) or both national classification and IPC B24B49/12		
Applicant EBARA CORPORATION et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 14.05.2004	Date of completion of this report 11.03.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Koller, S Telephone No. +49 89 2399-2841 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/JP 03/13171

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-41 as originally filed

Claims, Numbers

1-33 received on 14.05.2004 with letter of 14.05.2004

Drawings, Sheets

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/JP 03/13171

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	5-8,10-33
	No: Claims	1-4,9
Inventive step (IS)	Yes: Claims	
	No: Claims	1-33
Industrial applicability (IA)	Yes: Claims	1-33
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:
D1: US 2002/115380 A1 (YAMANE AKIHIKO ET AL) 22 August 2002
D2: US-A-5 672 091 (TAKAHASHI TSUTOMU ET AL) 30 September 1997
D3: EP-A-1 022 093 (APPLIED MATERIALS INC) 26 July 2000
D4: US 2002/022936 A1 (STANKE FRED E) 21 February 2002
D5: US 2002/013120 A1 (WISWESSER ANDREAS NORBERT ET AL) 31 January 2002
2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claims 1-4 and 9** is not new in the sense of Article 33(2) PCT.

Claim 1: The document **D1** discloses the following apparatus:

A polishing state monitoring apparatus comprising: a light source; a light-emitting unit disposed in a polishing table having a polishing surface, for applying light from said light source to a surface, being polished, of a workpiece; a light-receiving unit disposed in said polishing table, for receiving reflected light from said surface of said workpiece; a spectroscopy unit for dividing the reflected light received by said light-receiving unit into a plurality of light rays having respective wavelengths; light-receiving elements for detecting the light rays divided by said spectroscopy unit, and accumulating the detected light rays as electrical information; a spectral data generator for reading the electrical information accumulated by said light-receiving elements and generating spectral data of the reflected light; a control unit for controlling said light-receiving elements to perform a sampling process at a predetermined timing in synchronism with rotation of said polishing table; and a processor for calculating a predetermined characteristic value on said surface of said workpiece based on the spectral data generated by said spectral data generator.

For more details please refer to Fig.1, and paragraphs [0012], [0056], [0081], [0083] and [0100].

Claim 2: No additional technical feature is present.

Comment: The claim does furthermore not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved, which

merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

Claim 3: No additional technical feature is present.

Claim 4,9: The additional features are also known from document **D1**.

Comment

Claims 1,5,10,18,24,31 and 32: Although claims 1,5,10,18,24,31 and 32 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

3. **Claim 11:** The subject-matter of the independent method claim 11 does not meet the requirements of Article 33(1) PCT in the sense of inventive step (Article 33(3) PCT).

The subject-matter of the claim differs from **D1** merely by: "a calculation including a multiplication which multiplies the spectral data by a weight function".

The skilled person is aware of a plurality of mathematical models in order to analyse the obtained data for adjusting the polishing parameters. Departing from **D1** and by combining his common technical knowledge he would arrive at the subject-matter of claim 11 without an inventive step being required.

In addition the proposed calculation method is also shown in document **D3**.

4. The dependent apparatus claims, as well as the dependent method claims do not seem to contain any features which, in combination with the features of any claim to which they refer, would meet the requirements of the PCT in respect of inventive step, see documents **D1-D5** and the corresponding passages cited in the search report.

CLAIMS

1. A polishing state monitoring apparatus comprising:
a light source;

5 a light-emitting unit disposed in a polishing table having a polishing surface, for applying light from said light source to a surface, being polished, of a workpiece;

a light-receiving unit disposed in said polishing table, for receiving reflected light from said surface of said
10 workpiece;

a spectroscopy unit for dividing the reflected light received by said light-receiving unit into a plurality of light rays having respective wavelengths;

light-receiving elements for detecting the light rays
15 divided by said spectroscopy unit, and accumulating the detected light rays as electrical information;

a spectral data generator for reading the electrical information accumulated by said light-receiving elements and generating spectral data of the reflected light;

20 a control unit for controlling said light-receiving elements to perform a sampling process at a predetermined timing in synchronism with rotation of said polishing table; and

a processor for calculating a predetermined characteristic value on said surface of said workpiece based
25 on the spectral data generated by said spectral data generator.

2. A polishing state monitoring apparatus according to claim 1, wherein said control unit controls the timing of the sampling process performed by said light-receiving elements
30 so that a sampling point is located on a line interconnecting the center of said polishing table and the center of said workpiece.

3. A polishing state monitoring apparatus according to claim 2, wherein said light-emitting unit and said light-receiving unit pass across the center of said workpiece.

5 4. A polishing state monitoring apparatus according to any one of claims 1 through 3, wherein said control unit is capable of adjusting the sampling period of the sampling process performed by said light-receiving elements based on a rotational speed of said polishing table.

10 5. (amended) A polishing state monitoring apparatus comprising:

a light source;

15 a light-emitting unit disposed in a polishing table having a polishing surface, for applying light from said light source to a surface, being polished, of a workpiece;

a light-receiving unit disposed in said polishing table, for receiving reflected light from said surface of said workpiece;

20 a spectroscope unit for dividing the reflected light received by said light-receiving unit into a plurality of light rays having respective wavelengths;

light-receiving elements for detecting the light rays divided by said spectroscope unit, and accumulating the detected
25 light rays;

a spectral data generator for reading the information accumulated by said light-receiving elements and generating spectral data of the reflected light;

30 a control unit for controlling said light-receiving elements to perform a sampling process at a predetermined timing in synchronism with rotation of said polishing table; and

a processor for calculating a predetermined characteristic value on said surface of said workpiece according to a calculation including a multiplication which multiplies
35

wavelength components of the spectral data generated by said spectral data generator by a predetermined set of weighting coefficients.

5 6. A polishing state monitoring apparatus according to claim 5, wherein said characteristic value comprises a chromaticity coordinate value converted from said spectral data.

10 7. A polishing state monitoring apparatus according to any one of claims 1 through 6, wherein said light source emits light having a wavelength band.

15 8. A polishing state monitoring apparatus according to any one of claims 1 through 7, wherein said light source comprises a pulsed light source.

20 9. (amended) A polishing state monitoring apparatus according to any one of claims 1 through 7, wherein said light source comprises a continuous light source which is continuously turned on at least while said light-receiving elements are detecting the reflected light from said surface of said workpiece.

25 10. A polishing apparatus comprising:
a top ring for holding a workpiece;
a polishing table having a polishing surface which is brought in sliding contact with said workpiece;
a polishing state monitoring apparatus according to any one of claims 1 through 9; and
a light transmission unit mounted on said polishing
30 table for transmitting therethrough the light applied from said light-emitting unit of said polishing state monitoring apparatus and the reflected light from said surface of said workpiece.

11. (amended) A method of polishing a film formed on a workpiece, comprising:

applying light from a light source to a surface, being polished, of a workpiece;

5 detecting reflected light from said surface of said workpiece;

dividing the detected light and generating spectral data thereof;

10 calculating a characteristic value of said surface of said workpiece according to a calculation including a multiplication which multiplies said spectral data by a weight function; and

monitoring the progress of polishing of said surface of said workpiece using said characteristic value.

15

12. A method according to claim 11, wherein a characteristic point of time variation of said characteristic value is detected, and a polishing process is stopped or a polishing condition is changed when a predetermined time has elapsed after detection of the characteristic point.

20

13. A method according to claim 11 or 12, wherein said weight function is adjusted using the time variation of said characteristic value.

25

14. A method according to claim 13, wherein said weight function is adjusted by moving said weight function along a wavelength axis.

30 15. A method according to any one of claims 11 through 13, wherein said film comprises a metal film.

16. A method according to any one of claims 11 through 14, wherein said film comprises an oxide film.

5 17. (amended) A method according to claim 27, further comprising:

multiplying said spectral data by a desired second weight function different from said weight function and integrating the product to generate a second scalar value;

10 calculating a second characteristic value of said surface of said workpiece using said second scalar value; and

monitoring the progress of polishing of said surface of said workpiece using said characteristic value and said second characteristic value.

15

18. (amended) An apparatus for polishing a film formed on a workpiece, comprising:

a light source for applying light to a surface, being polished, of a workpiece;

20 a light-receiving unit for receiving reflected light from said surface of said workpiece;

a spectroscopy unit for dividing the reflected light received by said light-receiving unit;

25 a spectral data generator for generating spectral data from the divided light; and

a processor for calculating a characteristic value of said surface of said workpiece according to a calculation including a multiplication which multiplies said spectral data by a predetermined weight function.

30

19. An apparatus according to claim 18, further comprising:

an input unit for setting said weight function; and a display unit for monitoring said characteristic

35 value.

20. An apparatus according to claim 18, further comprising:

a polishing surface;

5 a top ring for holding said workpiece and pressing said surface of said workpiece against said polishing surface; a detector for detecting a characteristic point of time variation of said characteristic value; and

10 a control unit for stopping a polishing process or changing a polishing condition after elapse of a predetermined time from detection of said characteristic point.

21. An apparatus according to any one of claims 18 through 20, wherein said film comprises a metal film.

15

22. (amended) An apparatus according to any one of claims 18 through 20, wherein said film comprises an oxide film.

23. (amended) An apparatus according to claim 29, wherein said processor multiplies said spectral data by a desired second weight function different from said weight function and integrates the product to generate a second scalar value; and calculates a second characteristic value of said surface of said workpiece using said second scalar value.

25

24. (amended) A polishing state monitoring apparatus comprising:

a light source for applying light to a surface, being polished, of a workpiece;

30 a light-receiving unit for receiving reflected light from said surface of said workpiece;

a spectroscopy unit for dividing the reflected light received by said light-receiving unit;

35 a spectral data generator for generating spectral data from the divided light; and

a processor for calculating a characteristic value of said surface of said workpiece according to a calculation including a multiplication which multiplies said spectral data
5 by a predetermined weight function.

25. (amended) A polishing state monitoring apparatus according to claim 24, further comprising an input unit for setting said weight function and a display unit for monitoring said
10 characteristic value.

26. (added) A polishing state monitoring apparatus according to claim 5, wherein said light-receiving elements accumulate the detected light rays as electrical information.
15

27. (added) A method according to claim 11, wherein said calculation includes an integral which integrates said spectral data multiplied by said weight function to generate a scalar value.
20

28. (added) A method according to claim 11, wherein said weight function has a larger value for a large change in a wavelength range; and wherein said spectral data after a polishing end point differ from those before said polishing end
25 point.

29. (added) An apparatus according to claim 18, wherein said calculation includes an integral which integrates said spectral data multiplied by said predetermined weight
30 function to generate a scalar value.

30. (added) A polishing state monitoring apparatus according to claim 24, wherein said calculation includes an integral which integrates said spectral data multiplied by said
5 predetermined weight function to generate a scalar value.

31. (added) A polishing apparatus comprising:
a top ring for holding a workpiece;
a rotating polishing table having a polishing surface
10 which is brought in sliding contact with said workpiece;
a light transmission unit provided in said polishing surface;
a light-emitting unit for applying light to a surface, being polished, of said workpiece;
15 a light-receiving unit for receiving reflected light reflected from said surface of said workpiece and transmitted through said light transmission unit;
at least one light-receiving element for accumulating and releasing information of said reflected light; and
20 a control unit for controlling said light-receiving element to start releasing information of said reflected light based on a rotation angle from a line which interconnects the center of said polishing table and the center of said workpiece.

25 32. (added) A polishing apparatus comprising:
a top ring for holding a workpiece;
a rotating polishing table having a polishing surface which is brought in sliding contact with said workpiece;
a light source for applying light to a surface, being
30 polished, of said workpiece;
a light-receiving unit for receiving reflected light from said surface of said workpiece; and

a control unit for controlling energization of said
light source based on a rotation angle from a line which
interconnects the center of said polishing table and the center
5 of said workpiece.

33. (added) A polishing apparatus according to claim
32, further comprising:

a sensor mounted on the outer circumferential edge
10 of said polishing table for detecting a rotation angle of said
polishing table.